Epitomes
Important Advances in Clinical Medicine

Neurosurgery

The Scientific Board of the California Medical Association presents the following inventory of items of progress in neurosurgery. Each item, in the judgment of a panel of knowledgeable physicians, has recently become reasonably firmly established, both as to scientific fact and important clinical significance. The items are presented in simple epitome and an authoritative reference, both to the item itself and to the subject as a whole, is generally given for those who may be unfamiliar with a particular item. The purpose is to assist busy practitioners, students, research workers, or scholars to stay abreast of these items of progress in neurosurgery that have recently achieved a substantial degree of authoritative acceptance, whether in their own field of special interest or another.

The items of progress listed below were selected by the Advisory Panel to the Section on Neurosurgery of the California Medical Association and the summaries were prepared under its direction.

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Head Injury

THE CONSEQUENCES of minor and moderate head injuries have been the subject of ongoing controversy in the medical community for many years. Some have maintained that concussion is never associated with cognitive or behavioral sequelae, while others have argued that most patients suffering minor head injuries, and all with moderate head injuries, have at least transient cerebral dysfunction. Most recently, a series of objective studies has been carried out to detail both the short- and long-term consequences of head injuries that do not produce coma. Pioneering studies from New Zealand, followed by an important investigation at the University of Virginia, have suggested that minor and moderate head injuries can have long-term cognitive sequelae in a substantial number of patients.

It was recently shown that most patients who suffered a minor head injury, defined as a head injury producing a transient loss of consciousness and followed by a stay in hospital of no more than 48 hours, had evidence of transient cerebral dysfunction. Intellectual problems in the areas of memory, attention, and abstract thinking were seen on the initial evaluation within a week of injury. At one month, substantial improvement had occurred; at three months, the great majority of patients had returned to normal. About 15% continued to have significant cognitive sequelae, however. Behavioral manifestations such as headache, depression, insomnia, and imbalance or disequilibrium improved substantially in most patients at three months.

One can conclude from this multicenter study that minor head injury produces transient cerebral dysfunction, most of which is completely reversible and resolves within three months, but that there is a group of patients—"the miserable minority"—in whom long-term cognitive sequelae are present. In California alone, about 40,000 patients are admitted to hospital with minor and moderate head injuries each year. Many are dysfunctional for some months, either in the workplace or at home. Further delineation of this transient cerebral dysfunction and better treatment strategies for such patients are required.

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REFERENCES

Gronwall D, Wrightson P: Delayed recovery of intellectual function after minor head injury. Lancet 1974; 2:605-609

Levin HS, Mattis S, Ruff RM, et al: Neurobehavioral outcome following minor head injury: A three center study. J Neurosurg 1987; 66:234-243

Rimel RW, Giordani B, Barth JT, et al: Disability caused by minor head injury. Neurosurgery 1981; 9:221-228

Timing of Surgical Therapy for Aneurysms

THE SUCCESSFUL TREATMENT of intracranial aneurysms remains a major challenge to the specialty of neurologic surgery. Although alternative forms of interventional neuroradiologic procedures are being developed, the time-honored definitive procedure of choice in the treatment of ruptured saccular intracranial aneurysms remains microsurgical exposure and clip obliteration of the lesion.

It is estimated that about 28,000 subarachnoid hemorrhages occur per year in North America and that a third of patients die as a result of their initial hemorrhage or are misdiagnosed. The other approximate two thirds of these patients reach facilities with neurosurgeons capable of definitively caring for the lesion but only half of this patient population has a reasonable outcome. The other half—an estimated 9,000 persons—die of the complications of rebleeding and vasospasm or medical and surgical complications.

The goal of surgical intervention is to prevent rebleeding and facilitate the treatment of vasospasm. Although "late" intervention still has its proponents, a more urgent and early approach may offer a more favorable outcome. Modern principles of neuroanesthesia, adjunctive measures to produce a "slack" brain—using mannitol and cerebrospinal fluid drainage—combined with microsurgical techniques, a judicious use of temporary clips, minimal brain retraction, and dissection within the subarachnoid cisterns and outside the brain offer the opportunity to successfully clip off the offending aneurysm from the adjacent circulation. This can be done soon after the hemorrhage, thus obviating the risk to the patient of rebleeding. Operating early also provides a surgeon the opportunity to open up the arachnoid cisternal pathways and evacuate some of the "toxic" subarachnoid blood and the potential for the topical administration of agents to counteract vasospasm. In the days following early surgical intervention, a patient can be safely managed with hypervolemic-hypertensive therapy should vasospasm become a clinical problem. Surgical treatment is not advisable in those patients in the midst of severe vasospasm, another compelling reason to intervene early.

From a technical standpoint, the surgical repair of aneurysms can now be done early. Although operating early has no direct result either favorable or unfavorable on the subsequent potential problem of vasospasm, it does effectively treat the rebleeding problem associated with these lesions.

An acute physician and public awareness of the "sentinel bleed" or early warning leak that so often seems to occur just before a full-blown aneurysmal rupture can lead to a greater accrual of early and accurately diagnosed patients in good clinical condition. By combining this effort with operating early, the incidence and the morbidity and mortality associated with rebleeding from ruptured intracranial aneurysms can be significantly reduced.

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REFERENCES

Kassell NF, Drake CG: Timing of aneurysm surgery. Neurosurgery 1982; 10:514-519

Ljuggren B: Clinical and experimental aspects of timing in aneurysm surgery. Presented at the 13th International Joint Conference on Stroke and Cerebral Circulation, San Diego, February 1988

Rosenørn J, Eskesen V, Schmidt K, et al: The risk of rebleeding from ruptured intracranial aneurysms. J Neurosurg 1987; 67:329-332

Weir B: Epidemiology, *In* Aneurysms Affecting the Nervous System. Baltimore, Williams & Wilkins, 1987, pp 25-53

Intravascular Detachable Balloon Embolization of Intracranial Aneurysms

THE CURRENT TREATMENT OF CHOICE for intracranial aneurysms is neurosurgical clipping. This procedure may be compromised due to the anatomic location, configuration, size, or calcification of an aneurysm. Detachable balloon occlusion may provide an alternative therapy for selected cases of difficult aneurysms.

Under fluoroscopic visualization, a silicone balloon is flow-directed through the intracranial circulation and guided directly into the aneurysm. Using real-time subtraction or "road mapping" techniques, the balloon is inflated with a hydrophilic polymer, hydroxyethyl methacrylate, which solidifies to create a permanent embolic agent. The balloon is then detached within the aneurysm, and angiography is done to confirm occlusion of the aneurysm with preservation of the parent artery. Ectatic aneurysms without a neck may be treated by occluding the aneurysm or the parent artery (or both).

The procedures are done from a transfemoral approach using local anesthesia to permit continuous neurologic monitoring of the patient's condition. The technique has been used to treat aneurysms of the proximal, mid, and distal basilar, posterior cerebral, lateral posterior choroidal, cavernous internal carotid, posterior communicating, carotid ophthalmic, carotid bifurcation, and middle cerebral arteries.

Because intravascular embolization of intracranial aneurysms is still a relatively new therapy and long-term follow-up is required, the patient selection criteria are conservative. Our series of more than 200 includes patients with aneurysms in which standard neurosurgical clipping techniques have failed, aneurysms in surgically inaccessible areas, or aneurysms associated with high surgical morbidity or mortality, or patients judged to be clinically unstable for general anesthesia and craniotomy.

The largest reported series has been from the Kiev Neurosurgical Institute, where 532 aneurysms have been treated with a mortality of approximately 7%. In this series only those patients not treatable by balloon occlusion were treated by craniotomy and clipping. It is hoped that advances in materials, techniques, and scientific exchange will continue to improve this developing technology.

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REFERENCES

Debrun G, Fox A, Drake C, et al: Giant unclippable aneurysms: Treatment with detachable balloons. AJNR 1981; 2:167-173

Halbach VV, Hieshima GB, Higashida RT: Treatment of intracranial aneurysms by balloon embolization. Semin Intervent Radiol 1987; 4:261-268

Hieshima GB: Treatment of intracranial aneurysms by balloon embolization therapy, *In* Margulis AR, Gooding CG (Eds): Diagnostic Radiology, 1987. Berkeley, University of California Printing Services, 1987, pp 315-319

Higashida RT, Hieshima GB, Halbach VV, et al: Intravascular detachable balloon embolization of intracranial aneurysms: Indications and techniques. Acta Radiol [Suppl] (Stockh) 1986; 369:594-596

Romodanov AP, Shcheglov VI: Intravascular occlusion of saccular aneurysm of the cerebral arteries by means of a detachable balloon, *In* Krayenbuhl H, Brihaye J, Loew F, et al (Eds): Advances and Technical Standards in Neurosurgery, Vol 9. Vienna, Springer, 1982, pp 25-49

Indications for Cerebral Revascularization

CEREBRAL REVASCULARIZATION remains a viable treatment option for patients with cerebrovascular disorders. The International Cooperative Study of Extracranial-to-Intracranial Arterial Anastomoses helped to redefine and therefore limit the indications for these procedures and improved our understanding of cerebrovascular ischemia. An extracranial-to-intracranial (EC-IC) vascular anastomosis is clearly not efficacious in the treatment of patients with thromboembolic cerebrovascular disease. It is, however, a valid therapeutic option for a patient with the relatively rare recurrent transient ischemia from hypoperfusion that is refractory to optimal medical management.

The difficulty lies in deciding which patients suffer from cerebrovascular hypoperfusion and will therefore possibly benefit from revascularization of an ischemic vascular region. These patients must be studied and selected carefully. Attendant medical problems must be brought under optimal control. If patients remain symptomatic despite trials of aspirin and anticoagulants and they are reasonable candidates for an operation—from an anesthetic-risk perspective—then they may be considered for an EC-IC bypass procedure. Reproducible signs and symptoms of hemodynamic compromise must correlate with a demonstrable pathologic disorder on radiologic studies. Four-vessel head and neck angiography, including aortic arch views, is essential to document vascular occlusion or stenosis, the presence or absence of a collateral blood supply (or steal), and the location and caliber of extracranial vessels. Cerebral blood flow studies using stable xenon computed tomography with and without activation using acetazolamide (Diamox) have helped correlate ischemic symptoms with regions of relative hypoperfusion and limited autoregulatory reserve. Magnetic resonance (MR) imaging will reveal information about ischemia or infarction and is particularly useful when assessing posterior circulation vascular insufficiency. MR imaging will also document ventricular size and rule out other lesions, such as cyst, tumor, hematoma, or arteriovenous malformation, that might mimic ischemic cerebral disease.

EC-IC bypass remains an important adjunct in the treatment of patients with unclippable giant intracranial aneurysms. If hunterian ligation or an aneurysm-trapping proce-